Studies in Education No. 10

STANDARDIZING SHORTHAND TESTS

with special reference to vocabulary and word-length

By T. L. JAMES

NEW ZEALAND COUNCIL FOR
EDUCATIONAL RESEARCH
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FOREWORD

OUR COMMERCIAL SYSTEM CALLS FOR A CONTINUAL SUPPLY OF girls and young women proficient in the writing of shorthand, and, on a broad view, would seem to experience no great difficulty in finding enough applicants for posts where that art is required. The average business man may decry the attainments of the average stenographer; but his statement is *ex parte*, and in the absence of submissions from the other side, must be read in conjunction with his undoubted willingness to make use of her special skill. From his point of view and hers, that skill is attested, at the time of engagement, by the production of a certificate stating that she has written shorthand for a brief period at so many words a minute, and has deciphered it successfully.

The brief period of test upon which her acceptability seems to hinge is for the student and her teacher the culmination of long and arduous effort, in the course of which mental faculties have been at full stretch in pursuit of speed in the writing of outlines—speed in easy flow if possible, but, if not, speed at any cost. The better the teacher, the more likely is she—for here women greatly outnumber men—to have twinges of conscience about this mode of preparation, and a sense of unfairness about the final ordeal. Something is wrong; for quite often the results do not accord with her own judgment upon the relative worth of her students as shorthand writers.

Although teachers of technical schools in this country, as presumably in others, have long sought means of removing this or that fault in procedure, it still remains true that shorthand examinations tend to become associated with feelings akin to distrust and resentment; but feelings are notoriously bad pointers for pure research.

It is, then, trebly fortunate that this question should be attacked by a man proved in the business world, experienced in commercial teaching, and of natural objectivity of mind. From a rapid rise in municipal service and in the secretarial office of a large trading company, Mr. James turned to senior commercial duties in the Southland Technical College, where for some five years he quietly mastered the peculiar difficulties which such schools present. For the past eighteen years he has been in charge of the Commercial Department of the Technical College in Wellington.

A mind, preoccupied with the psychological factors involved in the act of writing shorthand, or unduly aware of the emotional tension evoked in candidates by such a short, sharp test, would be likely to share the dismay of the Mikado's expert set to play on 'a table untrue, with a twisted cue, and elliptical billiard balls'. Mr. James resolves much of the difficulty by envisaging the test as a mental race, and fixing his attention on factors that can be as clearly and as fairly set forth and accepted as are the details of an athletic contest. One might describe his measure of success by claiming that at any rate he leaves the billiard table level and the balls almost identical spheres.

His investigations must have been tedious in the extreme, but his explanations are terse, and his results simple, straightforward, and convincing. Indeed, he has secured, even in advance of this publication, the adoption of his main finding by a Consultative Committee set up by the Minister of Education to advise upon the requirements of the School Certificate Examination. This unexpectedly ready tribute to the reasonableness of Mr. James's findings should ensure acceptance for his essay throughout New Zealand, and a consequent easement of strain upon many a sensitive candidate. As a means towards producing fair conditions in shorthand examinations Mr. James's findings merit recognition in a wide field.

DUNEDIN
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W. G. ALDRIDGE

CONTENTS

Page

FOREWORD BY W. G. ALDRIDGE 3

I THE PROBLEM 7

II EXAMINATION PROCEDURE 11

III LINGUISTIC FACTORS 16

IV WORD-LENGTH 24

V MEASUREMENT OF WRITTEN SHORTHAND 31

VI SPEAKING-TIME-LENGTH 38

VII STANDARD WORD MEASUREMENT OF PAST EXAMINATIONS 40

VIII QUARTER-MINUTE SECTIONS 46

IX COUNTING SOUNDS 54

X SUMMARY 57

TABLES 60

I

THE PROBLEM

ONE OF THE MANY SUBJECTS FOR WHICH STANDARDIZED TESTS have been prepared is shorthand; a study of such tests shows that they are composed largely of the usual types of shorthand question. For example, that prepared by Edith V. Bisbee contains (1) 22 sentences to be written in shorthand; (2) a letter of 80 words to be dictated in one minute; (3) a letter of 180 words to be dictated at 60 words per minute; and (4) a spelling test based on the dictation of sentences. Such a test serves a useful purpose, for a teacher who uses it is able to compare the scores of his class with the published norms. It is, however, just such an examination as a teacher would use in his classroom. The only difference is that his would not have norms of achievement.

The disadvantage of tests like Bisbee's is that several such tests cannot be compared in difficulty without their being standardized on large samples of the same 'population'. If we have a footrule we can measure with it, and if we want another footrule, we can make one the same length as the first. But it is not so with these shorthand achievement tests. To find the 'length' of such a test we measure it by the children, not the children by it. If we develop another similar test we measure it by the children too, and so can compare test with test. But what is wanted is a set of carefully prepared standard measures by which we can standardize any test without having to submit it to the children.

The development of such standards would seem to require a very careful determination of the factors involved in difficulty and an equally careful measurement of these factors. Those who wish to test pupils in mechanical arithmetic, for example, want to know beforehand what constitutes a good measure of difficulty. In a long tot, for example, is the number of figures to be totalled a good measure? Does difficulty increase in proportion to the number of figures, or more than in proportion, or less? How does a double column compare with a single one of the same length? Only by having answers to these questions and others like them can a teacher know the comparative difficulty of the sums he is setting. He can then, if he wishes, increase the difficulty by regular steps as the class progresses, or can compare accurately the achievement of today with that of yesterday. In his teaching and in his testing he needs a measuring rod, a 'standard scale of difficulty', with which to assess beforehand the difficulty of the work. It is not sufficient to rely on the judgments of teachers in devising such a standard scale, for they cannot gauge accurately the variations in difficulty.

The inability to gauge variations in difficulty is one of the reasons for the frequent unreliability of the traditional type of examination, and the introduction of definite marking instructions and scales is an attempt to overcome the defect. One result has been the close study of questions set in examinations in school subjects, and of what is involved in answering them. There have been many investigations into the question of the relative difficulty of the component parts of various tests, but it is upon the successes and failures of the children themselves that the question has been answered for each test or part of a test. This represents a big step in the direction of standardization of difficulty. Another step has been the grading of the questions in standardized intelligence and specific ability tests. There is, however, one great difference between these standardized tests and the ordinary examination; the difficulty of the former has been determined by previous use, but this cannot be done with the latter. The questions are known only to the few who are preparing the examination.

The problem is to find a means of measuring beforehand the difficulty of the questions in examinations, or in any unstandardized tests, so that they may become more reliable tests of achievement; in other words, to find a scale of difficulty by which the tests themselves may be measured. In the following pages an attempt is made to indicate the lines along which such a scale might be constructed for shorthand.

By far the most important form of shorthand examination is the 'shorthand dictation passage'. It is obviously the appropriate type, since a very large part of classroom work is the writing of shorthand to dictation, in preparation for what is required in the world of work. The normal shorthand speed test provides for the dictation of a passage at so many words a minute for so many minutes. The standard of accuracy of transcription, which is the chief and sometimes the only measure of proficiency, is often expressed as the percentage that the number of words correctly transcribed bears to the number of words in the passage. The extent to which shorthand outlines are taken into account in examinations varies. Some examining bodies ignore them or look at them only to see that they have actually been written. Others deduct marks for bad outlines even when the transcription is good.

In classroom work the accuracy of outlines is very important and correction must be carried out until the system has been thoroughly mastered. Accurate outline is the basis of accurate transcript, and, in some examinations, to test accuracy of outline one or more questions are set which require the writing in accurate shorthand of given longhand passages. In spite of the fundamental importance of accurate outlines, however, this type of question does not find a place in shorthand speed tests. The assumption is that, though the outlines may deteriorate with speed, the theory has been sufficiently well learned and is sufficiently well applied for legible outlines to be written. I shall therefore devote attention to speed tests alone and attempt to develop a means of standardizing them more effectively than is done at present. The inquiry will take the line of examining in turn some important factors involved in the difficulty of such tests. These are: (1) examination procedure; (2) linguistic factors: (a) extent of vocabulary, (b) word-familiarity, (c) word-frequency; (3) word-length.

II

EXAMINATION PROCEDURE

THE USUAL METHOD IN AN EXTERNAL EXAMINATION IS FOR A person with a stop-watch to dictate the selected passage at the required speed, there being a second person to check the accuracy of both the dictation and the speed. The passage is divided into quarter-minute sections each of which must be dictated within that time. The standardization of dictation, even with experienced persons, involves many problems. When the examination is conducted in many centres at the same time, it is obviously necessary to have many dictators and many rooms. Hence there are variations in the conditions in the centres, arising from differences in the physical surroundings and in the persons concerned. The most important of these variations are to be found in: loudness and clarity of reading, in conjunction with position in the room, and with outside noise; dialect; familiarity with the dictator's voice and speech; pausation in reading; the weather and other physical conditions; and the physical, mental, and emotional condition of the candidates.

A short discussion of these will show some of the difficulties to be overcome. It goes without saying that the speaker should be heard without strain, and yet I have heard an examiner strange to the examinees wait till after the test to ask if he could be heard. Obviously, too, the candidate's place in the room affects hearing. What may be correct for those at the back of the room may be too loud for those in front. At any rate, as all are in different places there is no uniformity of hearing; it is not standardized. Clarity of diction is another important factor, for the pupils must hear every sound. The acoustic properties of the room are also important and are very difficult to standardize.

Dialect is probably less important in New Zealand than in some other countries, because all who take shorthand examinations speak 'New Zealand English', and all are sufficiently familiar with its varieties to understand without difficulty any person who would be selected to dictate; but familiarity with the dictator's voice and speech is a factor that cannot be ignored and candidates should have the opportunity of becoming acquainted with them before the examination.

The method of reading in relation to pausation is very important. Some read at a regular speech rate throughout the quarter-minute sections; others phrase much as they would in ordinary speech. As long as each fifteen-second bar is crossed at the proper time, the conditions are complied with. Clearly, pausation should be standardized. I might mention here the absence of any provision for time lag between the dictation and the writing. The examinees cannot begin to write till the first word has been heard, and this must necessarily result in their starting late. They may lose only a fraction of a second, but every moment is precious. On the other hand they must finish on the stroke of time, and they can do this only if the dictator finishes speaking a little before time.

No effort should be spared to overcome difficulties of hearing, voice, speech, and pauses. The dictator should read a preliminary test to make sure he can be heard and understood perfectly. He should be given the passage sufficiently long beforehand to prepare adequately to read it well and should have the opportunity to read it in the room aloud with another supervisor present to criticize him. Usually, if the teacher of the candidates is available, there can be no objection to her dictating; but if some candidates have been taught by one teacher, and some by another, there may be some objection.

The room and its furniture, its table and chairs, and the examinees' familiarity with them are other factors which it is hard to standardize when the examination is being held at several centres and when children come from various educational institutions. It is obviously impossible to standardize the weather, though appropriate action can be taken to counteract any adverse effects on the examinees.

But there is one important factor which it is impossible to standardize—the physiological and psychological condition of the examinees. We may give attention to certain physical conditions; we may regulate time of day and day of week; we may protect the candidates against disturbing noise and rigorous weather; but we cannot regulate the state of mind of the candidates themselves.

The great majority of the candidates are adolescent girls subject to greater emotional stress than boys of the same age or older people. In the examination, especially in an external one, an attack of nervousness may amount to temporary paralysis and so take control that the writing of legible outlines becomes very difficult, and to do so at the speed to which the candidate is accustomed is an impossibility. The nervous strain is greater than in other examinations. It is the sprint as against the long distance race. The candidate realizes that a pass depends on the work of five minutes, and there is no opportunity for the nervousness to wear off and for the candidate to settle down to work calmly. There are of course great individual differences in this respect, but everything that can be done beforehand to give the examinees full opportunity to settle down should be done. There seems no reason why the official dictator should not spend some considerable time dictating preliminary passages, so that attacks of 'nerves' will have time to subside. It has been suggested that in the preliminary work the inclusion of the dictation at examination speed of passages previously prepared and practised by the candidates might provide a still better approach to the ordeal of the examination—a suggestion worth investigation. The presence of a teacher whom candidates know, who can attend to any wants, and who can speak for them to the officials in charge, would also help to remove some of the external causes of nervousness.

In some of these matters of examination procedure there is an apparent conflict between the need for standardization and the existence of individual differences. The children themselves are not standardized; what suits one does not suit another. A table too high for one girl is too low for another; one likes loud dictation, another quiet; one works best in a room full of others, another is distracted by their presence.

Many of these differences are common to all examinations and have been present in the standardization of tests of all kinds. There is, however, a distinction to be drawn between those things which are part of the examination itself (e.g. the dictation) and those which constitute the environmental and personal conditions under which the test is given. The former should be perfected and standardized; the latter should be made as favourable as possible to each candidate. Where there is unfamiliarity it should be remedied; where there is excessive nervousness, it should be allayed; and where there are physical discomforts or distractions, they should be removed. As the purpose of the examination is to test accurately shorthand efficiency on a measured passage, no condition must be permitted to exist which would interfere with the accomplishment of this purpose.

III

LINGUISTIC FACTORS

SHORTHAND AND LONGHAND ARE ALIKE IN THAT THEY ARE both means of writing language by means of symbols, and any scale for measuring the difficulty of dictation passages must necessarily take into account the characteristics of language. The three aspects of language that will be considered here are: (a) extent of vocabulary; (b) word-familiarity; (c) word-frequency.

The Extent of the Vocabulary

All will agree that the vocabulary should be wholly within the range the pupils should have, and an examiner is not at liberty to use words beyond the ken of the examinees. What such words would be is at the present time largely a matter of opinion.

In the New Zealand School Certificate examination for 1934 the uncommon word 'exiguous' occurred, and in the same examination for 1941 the word 'vole' was used. Both of these words are outside the vocabulary of the normal third-year post-primary girl of about sixteen years of age. Their inclusion introduced an element prejudicial to the candidates and detrimental to the accurate measurement of their shorthand skill.

But if we agree that words should not occur beyond the range of the vocabulary the pupils should have, we are still faced with the problem of determining that vocabulary.

It can be fixed only with reference to the purpose of the examination. In a Chamber of Commerce examination designed to select those who have reached the required standard for general commercial work the vocabulary could reasonably be less extensive than that required in the Court Reporters' examination.

The ideal would be for each examining body to prepare its own test vocabulary. In doing so it would have to keep in mind the type of applicant wanted in respect of age, intelligence, verbal ability, and general education. It would not set a standard higher than was necessary and it could reasonably make allowance for the fact that a candidate's vocabulary would be enlarged during employment.

It would not be difficult for an examining authority to prepare its own list of words. There are available as a guide such books as Professor E. L. Thorndike's *The Teacher's Word Book*, and Professor Ernest Horn's *A Basic Writing Vocabulary*, each containing a list of 10,000 'most common' words, and there will shortly be another prepared from a very extensive count Professor Thorndike is now making. The words are naturally based largely on American usage, but the lists could be revised so that there could be a general word list suitable for New Zealanders. Words important in the light of the purpose of any particular examination could be added to the list. Failing such standardized vocabularies, we are thrown back upon less precise measures. Professor Lewis M. Terman includes in his Stanford Revision of the Binet-Simon Individual Intelligence Tests certain vocabulary tests. On the basis of the samples used, a normal child fourteen years old is expected to know at least one meaning of each of 9,000 words, the average adult, of 11,700, and the superior adult, of 13,500. To the extent that New Zealand conditions and standards are comparable with those in the United States of America we could expect persons in New Zealand to have a general vocabulary of the same size. It would be wrong, however, to assume that a pupil of sixteen years of age who passed the vocabulary test for the average adult would necessarily include in her vocabulary the 11,700 most common words. Perhaps she would include 10,000 of them; I do not know. But the important points are that for the regulation of the difficulty of shorthand examinations the extent of the vocabulary should be fixed in some definite way, and that where no special list of words is employed it is reasonable to fix it with reference to the frequency with which words occur. To illustrate this principle I have analysed the dictation passages for three years of the New Zealand Public Service Junior Entrance Examination for Female Shorthand Writers and Typists (commonly called the Public Service Junior Shorthand-Typists' Examination). I have extracted from the tests for the three years the words which do not appear in Thorndike's *The Teacher's Word Book* containing the 10,000 most frequently occurring words in the sample he used, and listed them in Table I as words over the 10,000 word level. The candidates for the examination are trained both in public and private post-primary schools, including the private commercial schools. As it is a well-known examination, many sit for it who do not intend entering the State service. The dictation passages are invariably taken from Hansard, alterations being made where they seem advisable. The tests analysed are of five minutes' duration at a speed of 80 words a minute, and the three years chosen (1925, 1927, 1940) are typical of the examination over many years.

Some of these words, e.g. 'unemployed', seem common enough and suggest the desirability of keeping any vocabulary list up-to-date by periodical revision. 'Wellington' should also be known to all New Zealanders.

TABLE I

WORDS NOT INCLUDED IN THE THORNDIKE LIST

(Public Service Junior Shorthand-Typists' Examination)

1925	*1927*	*1940*
confiscation conversant productive regrettable	entailed Wellington	absorption beneficial equitable expedite revision seasonal unemployed

But even if allowance is made for any alterations due to changes that have taken place in the common vocabulary since that list was prepared, and also for New Zealand conditions, differences still remain. The obvious, and correct, interpretation of Table I is that the 1940 examination,with seven words above the 10,000 word level, required the most extensive vocabulary, and the 1927 examination the least extensive. The 1940 examination certainly did have the greatest number of 'uncommon' words. But what is of more general importance than the few words in the lists in Table I is the extent of the vocabulary needed to include those words. The differences are not only those of seven, four, and two words, for these would not be immediately above the 10,000 level, but between the points in the word-list extending upwards in order of decreasing frequency, at which the words in the respective examinations will be included. It is not a part of my plan to attempt to suggest the vocabulary for any particular examination. I have indicated that extent of vocabulary is one of the factors involved in difficulty and as such would need to be regulated by examining bodies in order that their examinations would maintain an unvarying standard from year to year.

Word-Familiarity

The second point that should receive some consideration is the relative familiarity of the words used. A less familiar word is less quickly responded to than a more familiar one. The response will vary to some extent from one person to another, though no doubt the most common words will be familiar to all. Beyond the common stock of words individual differences will become more and more pronounced till we reach those words which are unknown to some examinees. If there were authoritative vocabularies for the various examinations, that stage should be reached somewhere beyond the range of the specified vocabularies, but under present conditions it will be reached somewhat earlier.

TABLE II

WORDS GROUPED ACCORDING TO FREQUENCY INTERVALS (THORNDIKE LIST)

Frequency Interval	1925		1927		1940	
	No.	Per cent	No.	Per cent	No.	Per cent
1- 500	107	58	108	65	100	50
501- 5000	69	37	49	30	80	40
5001-10000	6	3	6	4	15	7
Above 10000	4	2	2	1	7	3
Totals..........	186	—	165	—	202	—

The point of importance here is that, other things being equal, a test with a large percentage of unfamiliar words will be harder than one with a small percentage. The assumption was made that the more frequently a word occurs in our language the more familiar it will be, and so Table II was prepared to show in summary form, and grouped according to frequency, the numbers of different words in the three Public Service Shorthand-Typists' Examination tests previously used.

It is clear that the 1940 passage was hardest. Not only did it contain the smallest number (100) and percentage (50) of 'most familiar' words (Group 1–500), but also the largest number (102) and percentage (50) in the 'less familiar' groups. The 1927 passage was easiest, containing the largest number (108) and percentage (65) in the 'most familiar' group, and the smallest number (57) and percentage (35) in the 'less familiar' groups.

Passage Word-frequency

The difficulty of a shorthand speed test is also affected by the number of words, and consequently of outlines, occurring more than once; and by the number of different words, and consequently of different outlines, in the passage. Because the recurrence of a word affects the number of different words, these two factors are to some extent related. Except perhaps with perfectly familiar words, the more recently a word has been heard and written, the more easily will it be reproduced, other things being equal. When words occur a second or a third time in a passage, they will be more easily written on these subsequent occasions, and the greater the number of such repeated words, the easier will the passage be.

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As hypothetical illustrations of differences of word-frequency, the figures of four passages of 400 words each (*A*, *B*, *C*, *D* below) may be given:

	Passage A	*Passage B*
No. of different words	200	200
No. of different words (included in the 200 above) occurring more than once	100 (average of 3 times each)	50 (average of 5 times each)
No. of different words occurring only once	100	150

	Passage C	*Passage D*
No. of different words	200	175
No. of different words (included in the 200 and 175) occurring more than once	50 (average of 5 times each)	50 (average of 5½ times each)
No. of different words occurring only once	150	125

For the reason given above *A*, with 100 repeated words, will be easier than *B* with only 50. It is true that in *B* the greater number of repetitions will result in more improvement in each of the 50 repeated outlines than there will be in each of the 100 in *A*; but, as on the average greater absolute improvement will take place when an outline is written a second or a third time than when written a fourth or a fifth, the total improvement in the 100 words in *A* will exceed that in the 50 in *B*.

The advantage of having fewer different words is obvious. There will be fewer first occurrences, and consequently fewer occasions on which there is an absence of the recency benefit; the advantage more than outweighs the benefit from a slightly higher rate of repetition. *D*, with 175 different words, is therefore easier than *C* with 200.

An analysis of the three Junior Shorthand-Typists' test passages referred to earlier is summarized in Table III. The 1927 passage was easiest on both counts; there was the greatest number of repeated words (63) and the smallest number of different words (165). The 1940 passage was the hardest of the three with only 55 words occurring more than once and with 202 different words.

TABLE III

FREQUENCY OF WORD OCCURRENCE IN THREE EXAMINATIONS

	1925	1927	1940
No. of words in five-minute test	400	400	400
No. of words occurring once	124	102	147
Percentage of words occurring once	31	26	37
Balance of passage comprised of words occurring more than once	276	298	253
Percentage of such words	69	74	63
No. of different words in passage	186	165	202
No. occurring more than once	62	63	55

If all the words and their outlines were perfectly familiar, as they would be to an experienced shorthand writer with a wide vocabulary, the effect of variations in frequency would be negligible. But the children whom we teach are not so fully experienced, and so in the grading of passages consideration should be given to the number and frequency of words. It should not be onerous to do this.

The three linguistic factors dealt with in this section are closely related. The extent of the vocabulary has a bearing on familiarity, and familiarity is governed by frequency. They should nevertheless be given separate attention in the grading of dictation passages.

IV

WORD-LENGTH

IS THE METHOD OF MEASURING SHORTHAND DICTATION PASSAGES in words satisfactory, and, if not, is there a better? Words whether measured in syllables, in sounds, or in letters vary tremendously in length; indeed, teachers on reading passages for dictation will pass such judgments upon them as 'easy' or 'fair' or 'hard', basing their opinions at least in part upon the observed length of the words. The possibility of finding a better way is suggested by the improvement effected in measuring passages for typewriting speed tests by the change from the word to the stroke method, an improvement so beneficial that the number of strokes per word is now regularly taken into account.

Measurement by syllables has naturally suggested itself to some examining bodies, and we find that the average number of syllables per word is prescribed in their examination syllabuses by some such expressions as 'about 1.4', '1.5', 'from 1.4 to 1.6'. In other cases examiners themselves decide upon such a standard for their own personal guidance. Such measures invariably make for better standardization, especially when the minute and quarter-minute sections are marked off in syllables. But shorthand is phonetic; it represents by symbols the stream of sounds which constitute speech. It seems to me that there is consequently only one logical standard of measurement for any system of phonetic writing, and that is the speech sound. Just as typewriting reproduces the written letters of which the written syllable and word are composed, so phonetic writing reproduces the spoken sounds of which the spoken syllable and word are composed.

The most important characteristic that a standard unit of measurement must possess is stability. The great objection to words, and to a less extent, to syllables as standard units of measurement is that they are not sufficiently stable in phonetic length. Individually they both vary tremendously; 'a' is one word of one sound, 'departmentalization' is one word of nineteen sounds; 'a' is one syllable of one sound, 'strides' is one syllable of seven sounds. On the average they will vary much less than this from passage to passage, but the variation is still considerable.

In order to get some measure of the variation in the average length of word in different test passages, thirty dictation and vocalization passages taken from the public examinations in New Zealand and from Pitman's publications were selected for examination. Thirteen were dictation passages from New Zealand public examinations; seven were vocalization passages from these examinations, six were dictation passages from *Pitman's Office Training*, and four were dictation passages based on *Pitman's 700 Common-Word Reading and Dictation Exercises*. The mean length per 100 words was calculated for each passage in syllables, sounds, and letters and the results are shown in Table A at the end. (Table B gives percentage index numbers used for the construction of Figure I.) It should be remarked that the passages were chosen for their variety in respect of word-length, so that tendencies would stand out prominently.

Letters were included in the calculation not because it is logical for purposes of phonetic writing to measure the length of words in letters, but because that might be a second or third best method. Shorthand systems may not be strictly phonetic; Pitman's system, for example, provides for the writing of the silent 'r' that occurs in so many of our English words and often treats as a single sound a letter which represents two sounds, e.g. 'j' (ʤ) as in 'just' is treated as a single sound. Such an arrangement, which may be very useful in a particular system, tends to make the shorthand phonetic length of a word correspond more closely to the letter-length than it otherwise would.

TABLE IV

MEASURES OF CENTRAL TENDENCY AND DEVIATION OF WORD-LENGTH IN THIRTY SELECTED SHORTHAND PASSAGES

Measure	Syllables per word	Sounds per word	Letters per word
Mean of 30 passages means	1.56	4.25	4.70
Highest passage mean	2.06	5.96	6.25
Lowest passage mean	1.18	3.41	3.90
Mean deviation	0.15	0.39	0.37
Standard deviation	0.20	0.54	0.51
Coefficient of variation	12.60	12.80	10.90

Table IV shows clearly the amount of variation that can take place; it may be illustrated in another way by pointing out that the average word of the passage with the longest words had 75 per cent more syllables and sounds and 60 per cent more letters than that with the shortest. A point that comes out clearly is that the average word varies more in the number of syllables and sounds it contains than it does in the number of letters. In syllables the standard deviation is 12.6 per cent of the average; in sounds it is 12.8 per cent; and in letters it is 10.9 per cent. The corresponding figures

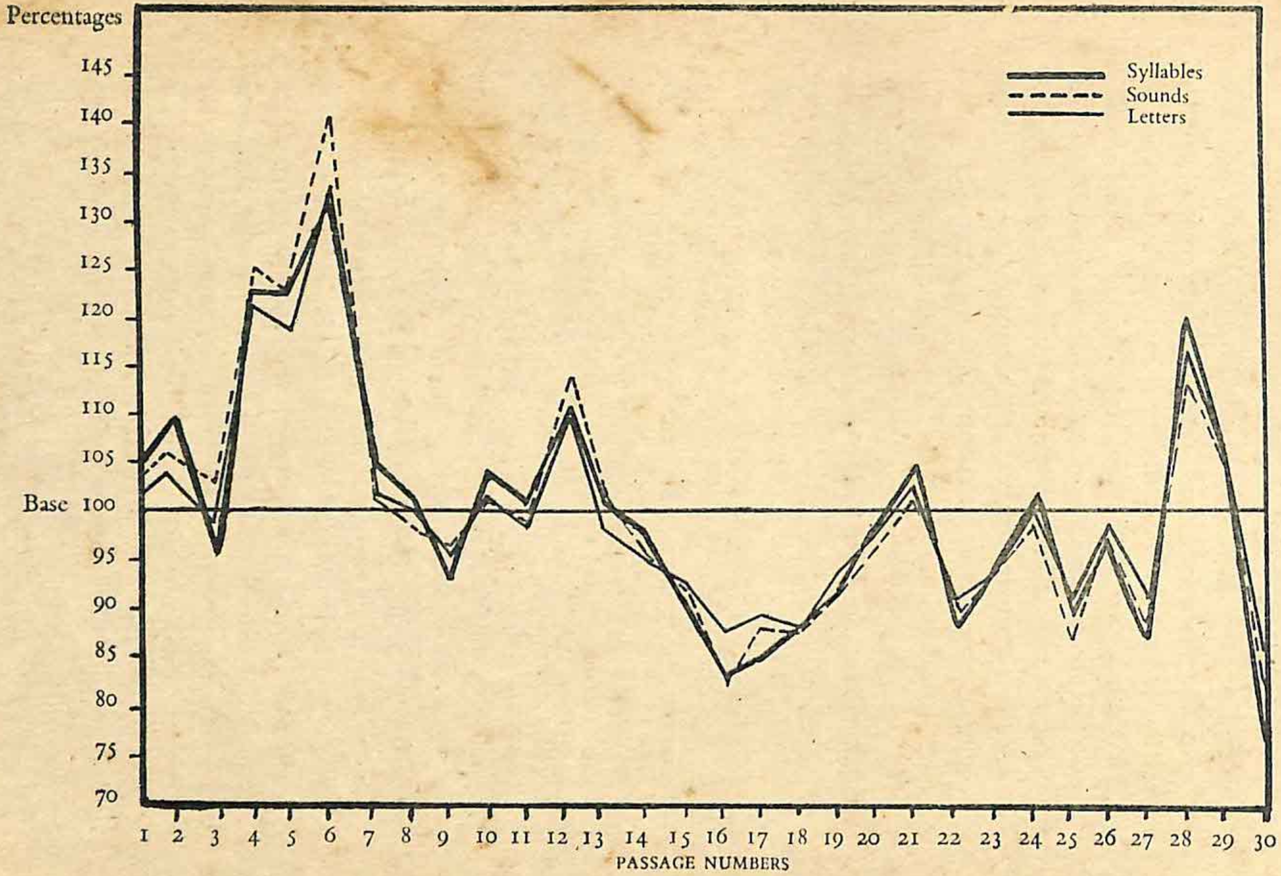

Fig. I. Percentage index numbers for syllables, sounds, and letters (mean lengths per 100 words for thirty passages). See also table B at end.

for the mean deviation are 9.7 per cent, 9.2 per cent, 7.9 per cent. Since the most conspicuous length of a word is its written letter-length, it is important to remember that this shows the lowest ratio of average variation.

But as we are concerned with the variation that may take place in examinations, individual passage variation is as important as the average variation of all the passages. In Fig. 1 the average of the thirty-passage averages is represented by the base line. The diagram shows clearly that in only two instances out of ninety is the individual passage average the same as the thirty-passage average, and it brings out the great amount of variation that occurs from passage to passage. The general opinion that words constitute an unsuitable standard unit of measurement is fully confirmed.

An examination of syllables as the unit of measurement shows that there is considerable variation in them also. To measure in syllables is also to measure with a unit that is itself not constant. Table V shows that the average syllable in the passage with the longest syllables has fifteen per cent more sounds and letters than that with the shortest. As the comparable figure for words was 75 per cent, and as the coefficient of variation for sounds per syllable is only 3.24 as compared with 12.8 for sounds per word, it is obvious that the syllable is considerably better than the word as a standard unit of measurement, but inasmuch as it does vary considerably in sound-length it is still not the best for a system of phonetic writing. Moreover, there is no correlation between the length of a word in syllables and the length of a syllable in sounds. (For the thirty passages the correlation (*r*) was 0.15 ± 0.12.) In a passage of polysyllabic words, the syllables are just as likely to be long in sound-length as short, and likewise in one of monosyllabic words. Two passages could therefore be of equal syllable-length and the words could be of equal syllabic intensity; yet one could be fifteen per cent longer in sound-length than the other.

TABLE V

MEASURES OF CENTRAL TENDENCY AND OF DEVIATION OF SOUND AND LETTER LENGTH OF SYLLABLES IN THIRTY SELECTED SHORTHAND PASSAGES

Measure	Sounds per syllable	Letters per syllable
Mean of 30 passage means	2.72	3.02
Highest passage mean	2.93	3.31
Lowest passage mean	2.55	2.89
Mean deviation	0.07	0.07
Standard deviation	0.09	0.09
Coefficient of variation	3.24	3.11

Another point is that the average number of letters per syllable varies as much as the average number of sounds. The syllable is sufficiently variable in both sound- and letter-length to make its use undesirable. There is, further, a negative correlation of -0.65 for the thirty passages between the average number of syllables per word and the average number of letters per syllable. As words increase in syllable-length, the syllables tend to become shorter in letter-length. As was shown above, this is not the case with the sound-length of the syllable. It follows that as a word increases in syllable-length it increases *on the average* more in sound-length than in letter-length. Table C at the end and Fig. II give the details on which the above discussion is based.

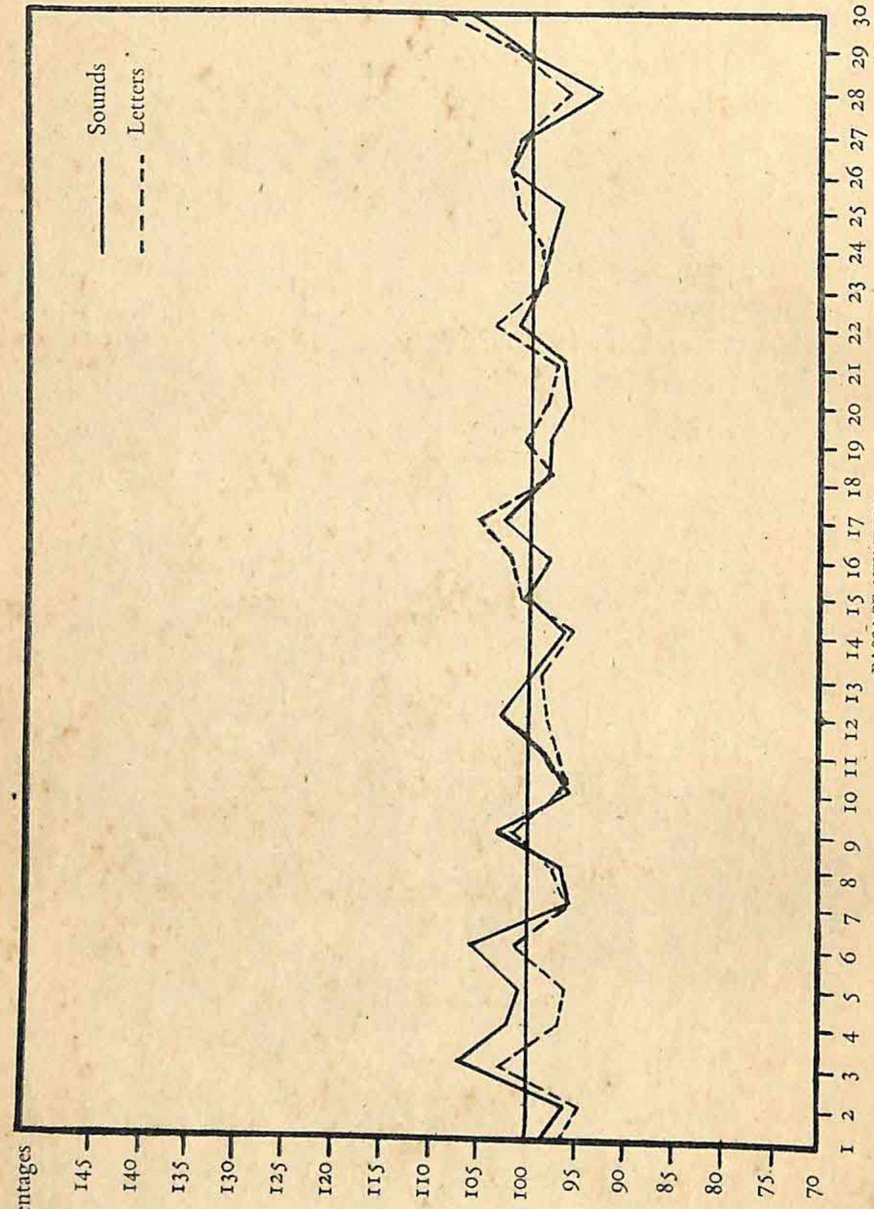

Fig. II. Sounds and letters per syllable (mean lengths per 100 words for thirty passages). See also Table C at end.

V

MEASUREMENT OF WRITTEN SHORTHAND

SO FAR I HAVE DEALT WITH SPOKEN LANGUAGE, AND HAVE recommended that the sound and not the syllable, the word, or the letter be the standard unit for measuring length. That conclusion was reached without reference to any particular system of phonetic shorthand and it would apply equally to all such systems. The next point to consider is the measurement of written shorthand and the extent to which it coincides with sound-length.

An attempt was made to measure shorthand time-length, i.e. time taken to write shorthand, and to compare it with syllable-length, sound-length, and letter-length. An experiment was planned to ascertain the shorthand time-length of each passage by finding the average time a group of girls would take to write it. The time-lengths so ascertained could then be compared with sound-, syllable-, and letter-lengths of the passages to determine with which they were most closely related.

The girls who volunteered for the work on two successive Saturday mornings could write about 80 words a minute. Dictation was, however, out of the question as the speed would then have been standardized. Further it was desirable that 'pure' time, unaffected by pauses due to outline difficulty, should be obtained. So the passages were divided into sections short enough to be memorized, and were written on the blackboard in both longhand and Pitman's shorthand. The shorthand for each section was practised for a few minutes till it could be written fluently. The girls then wrote it as many times as possible in one minute without sacrificing the quality. As the passages were not of equal length the average time-length per 100 words was calculated, with the results shown in Table VI.

TABLE VI

AVERAGE TIME-LENGTH PER 100 WORDS OF TEST PASSAGES

Passage No.	Time in seconds	Syllables	Sounds	Letters
1	59.5	165	445	483
2	55.0	171	450	492
3	55.6	149	438	466
4	61.0	193	531	569
5	58.2	192	523	560

The weaknesses of the experiment were: First, as the girls were students, they were improving not only through the practice afforded by the experiment, but also through their normal lessons. I am inclined to think this explains the relatively faster times per sound for Passages 2, 3, 4, and 5. Second, the work was done for two hours on each of two successive Saturday mornings. Even though rests were taken, there was some evidence of either fatigue or boredom. The relative increase in the time per sound for Passage 3 could thus be partly accounted for, as it was done during the last forty minutes of a two-hour sitting. Third, all of the girls could not attend on both occasions, so that the scores of those who attended only once had to be omitted; only eight were left. Worked on the basis of passages of one hundred words, the correlation (*r*) between word-length and shorthand time-length could be no other than 0; that between time- and

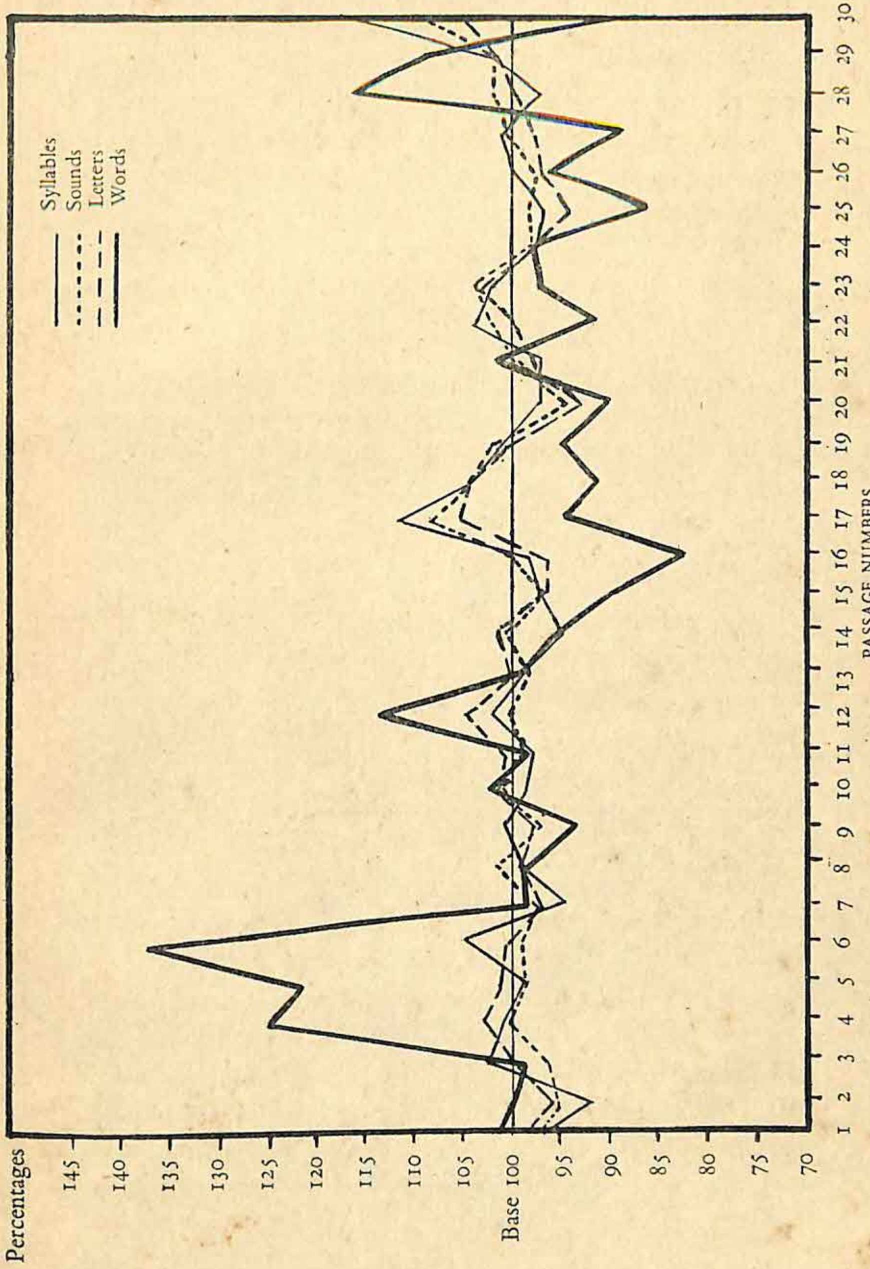

Fig. III. Symbol-lengths of syllables, sounds, letters, and words (mean lengths per 100 words for thirty passages). See also tables A, B and D at end.

syllable-length was 0.61 ± 0.19; that between time- and sound-length 0.64 ± 0.18, and that between time- and letter-length 0.68 ± 0.16. With due allowance for the conditions of the experiment, it showed clearly the superiority of syllables, sounds, and letters over words as units of measurement. The earlier finding, that words are not a good measure of shorthand passages, is confirmed.

Length in Shorthand Symbols

The next comparison made was that between symbol-length and syllable-, sound-, and letter-length. To determine the symbol-length of the advanced style of Pitman's system the symbols were counted. Full-length and half-length strokes, circles, hooks, dots, vowel dashes, 'hay', 'way', 'yay', and diphthong symbols were each counted as one, and double-length strokes and triphones each as two. The 'symbol-length' of the passage was then the number of shorthand symbols in it.

These symbols cannot, of course, all be written with equal facility. Their length, shape, thickness, combination, direction, and position all affect facility and speed. Nevertheless, Tables A and B at the end and Fig. III show how closely symbol-length is related to sound-length and letter-length. The coefficients of correlation are:

Symbol-length and syllable-length.... 0.47 ± 0.10
Symbol-length and sound-length...... 0.97 ± 0.01
Symbol-length and letter-length...... 0.94 ± 0.01

It is not surprising to find the correlation between symbol-length and sound-length high in a phonetic system. It is also interesting to find that there is a correlation of only 0.47 between symbol-length and syllable-length. As a standard unit of measurement, the sound is first, the letter second, the syllable third; the word is unsatisfactory.

Another comparison that may be made is of the symbol-lengths of the syllable, the sound, the letter, and the word. The more constant the number of symbols per unit, the better will that unit be as a measure of the symbol-length. Once again the sound and the letter show up as the best units of measurement, as Table D at the end and Fig. III indicate. Table VII summarizes the statistics.

TABLE VII

MEASURES OF CENTRAL TENDENCY AND OF DEVIATION OF SYMBOL-LENGTH OF THE SYLLABLE, THE SOUND, THE LETTER, AND THE WORD IN 30 SELECTED PASSAGES

	Symbols			
	Per syllable	Per sound	Per letter	Per word
Mean of 30 means.	1.28	0.47	0.42	2.00
Range	0.37	0.07	0.06	1.10
Mean deviation.	0.15	0.01	0.01	0.17
Standard deviation.	0.07	0.02	0.01	0.24
Coefficient of variation. . .	5.40	3.58	3.48	12.00

It is obvious that the word, with a standard deviation of 12 per cent of the average and individual deviation as great as 37.5 per cent, cannot be used to measure the symbol-length of a passage. The syllable, with standard deviation of 5.4 per cent of the average and mean deviation of 16.1 per cent, is better; but the sound and the letter are better still. Their standard deviations are only 3.6 per cent and 3.5 per cent of their respective averages—so close to each other that the difference is insignificant. Only twice do the curves for the two in Fig. III move in opposite directions while the curve for symbols per syllable moves in the direction opposite to that for symbols per sound eight times and to that for letters seven times. Two other coefficients of correlation, which, when compared with that of 0.47 given above for symbol-length and syllable-length, further support the sound or the letter as against the syllable, are those between:

Symbol-length and sound-length of syllable . . 0.71 ± 0.06
Symbol-length and letter-length of syllable . . 0.71 ± 0.06

The assumption has however been made that the symbol-length of a passage is closely related to the speech-sound length. This raises a very important question: In a shorthand examination is it the shorthand length of the dictation passage that should be measured, or the speech-sound length of that passage? It seems to me that the speech-sound length is merely the length of the question, while the shorthand length is the length of the answer. Indeed the whole question of measurement may appear to have been tackled from the wrong end, for it may be contended that it is not the question that is difficult (though we often speak as though it were), but the answering of it. We should, therefore, standardize the difficulty of the shorthand, of which one factor is its length. We would then speak of a speed of so many symbols a minute.

There is no valid reply to these contentions. We have assumed perfect correlation between question and answer, between speech-sound length and shorthand length, and if it does not exist, standardizing the question will not standardize the answer. On the other hand, in attempting to measure the speech-sound length, we have tried to be practical. Speech-sound length, especially when expressed in words per minute, is understood by everyone. The examinee, the business man, the teacher, all know at least roughly what it means. Besides in many examinations any recognized system of shorthand may be written. To have a different measure of shorthand length for each system would lead only to confusion. It must be admitted, however, that examiners do recognize the difference between question and answer, and in setting a test carefully scrutinize the outlines as well as the words. They know what outlines are hard to write.

I have shown that in Pitman's system there is a correlation of 0.71 between symbols per syllable and sounds and letters per syllable, of 0.97 between symbol-length and sound-length, and of 0.94 between symbol-length and letter length. It is fair enough to say, on the basis of the methods used in this investigation, that we are achieving the closest approximation to shorthand length when we use sound-length as an indirect measure.

VI

SPEAKING-TIME-LENGTH

THE METHOD OF MEASURING SHORTHAND BY WORDS CAN BE challenged in yet another way. Speaking occupies time, and there is a limit to the rate at which any individual can speak. It is obvious that the limit is not reached at so many words a minute, for if words are long the limit may be somewhere between 200 and 300; if they are short it may be nearer 400. The very mention of 'long' and 'short' is a recognition that they are not of equal length.

In earlier sections the syllable-, sound-, and letter-length of words have been examined, and compared with the symbol-length of the shorthand. I also devised an experiment to measure speaking-time-length, the principle being to compare the normal speaking-time of certain passages with their syllable-, sound-, and word-length. Thirty quarter-minute sections were chosen from various examination passages. They were in pairs, a long section and a short one from the same passage constituting a pair. They varied in word-length according to the number of words per minute at which the original tests were dictated. Ten experienced readers timed themselves on the reading of each of the thirty extracts, and the average speaking-time per word was calculated, with the results shown in Table E at the end. The correlation between sound-length and speaking-time-length was 0.99 ± 0.002.

The evidence so far may now be summarized. Shorthand is phonetic, being based on the writing of symbols for sounds or combinations of sounds, but not for syllables or words except to a limited extent. The use of the word as a standard unit of measurement of dictation passages is therefore logical only if it maintains the same average length from passage to passage. This it does not do; it varies tremendously in syllable-length, sound-length, letter-length, and speaking-time-length. Nor is it any more satisfactory as an indirect measure of shorthand length of the passages, whether this is gauged by shorthand writing-time or the number of symbols. The syllable is a better measure than the word, but it, too, varies sufficiently to render it only a rough measure of both dictation (or question) and shorthand (or answer) length. The sound, and, to a less extent, the letter are much better measures. The sound is the best standard unit of measurement for both the dictation length and the shorthand length of the passage.

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VII

STANDARD WORD MEASUREMENT OF PAST EXAMINATIONS

THE THIRTY SELECTED PASSAGES WHICH HAVE SO FAR BEEN studied were selected for their variety. In addition to ordinary dictation passages they included at the one extreme difficult vocalization pieces, and at the other, pieces based on Pitman's 700 common words. It is now necessary to analyse ordinary dictation passages that have been set by examining bodies of repute, passages in the choice of which the utmost care has been taken.

The investigation covered forty-eight such passages, set by five different bodies, and with speeds ranging from 50 to 190 words a minute. These were: New South Wales Department of Education, Incorporated Phonographic Society of Australia, New Zealand Public Service Commissioner, Sir Isaac Pitman and Sons Ltd., Wellington Chamber of Commerce. In what follows these bodies have been designated by the letters A, B, C, D, E, which have not been assigned in the above order.

The sounds in these tests were counted, in all over 100,000 sounds in over 25,000 words, and the average number of sounds per word was calculated for each passage. Table VIII gives the results, which are illustrated in Fig. IV. It is apparent that there is no consistency (a) among the different tests of any one examining body, or (b) from year to year in the same speed test of any one examining body,

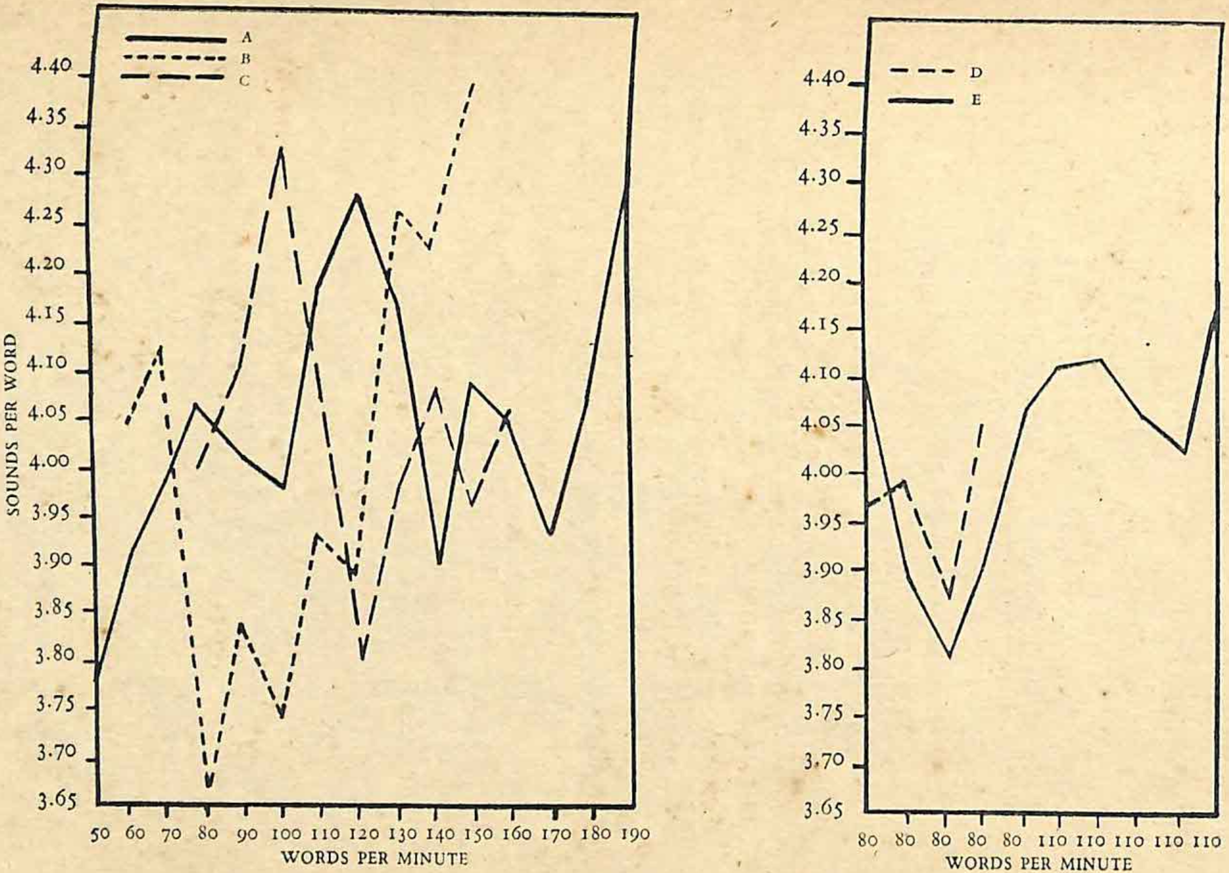

Fig. IV. Average sound-lengths of words in five examinations. See also Table VIII.

or (c) among the tests at the same speed of the different examining bodies. I would not have been surprised to find a gradual increase in the sound-length of the average word as the speed increased, as there are those who believe that this should be the case; but it was not found. There was variation, but not gradual increase.

TABLE VIII

AVERAGE SOUND-LENGTH OF WORDS IN EACH OF FORTY-EIGHT EXAMINATION DICTATION PASSAGES

Speed in words per minute	Examining authority				
	A	B	C	D	E
50	3.78	—	—	—	—
60	3.91	4.04	—	—	—
70	3.99	4.12	—	—	—
80	4.06	3.67	4.00	3.97 3.99 3.87 4.05	4.10 3.89 3.82 3.90 4.06
90	4.01	3.84	4.10	—	—
100	3.98	3.74	4.33	—	—
110	4.17	3.93	4.07	—	4.11 4.12 4.06 4.03 4.16
120	4.27	3.89	3.80	—	—
130	4.16	4.26	3.98	—	—
140	3.90	4.23	4.08	—	—
150	4.09	4.39	3.96	—	—
160	4.05	—	4.06	—	—
170	3.93	—	—	—	—
180	4.07	—	—	—	—
190	4.31	—	—	—	—
Mean	4.05	4.02	4.04	3.97	4.03

The important conclusion to be drawn from the evidence put forward in this investigation is that in shorthand speed tests the number of sounds per word should regularly be taken into account by providing for a 'standard' word of so many sounds. Fortunately the number of sounds per word is not difficult to determine. The average of the dictation passages in Table VIII was 4.02, and most people will agree that four sounds per 'standard' word will do very well. The number of sounds in a passage divided by four will give the length of that passage in standard words, and this divided by the dictation time in minutes will give the standard words per minute.

TABLE IX

COMPARISON OF TEST PASSAGES IN LENGTH AND SPEED UNDER WORD AND STANDARD WORD METHOD OF MEASUREMENT

Speed in words per minute	Speed in standard words per minute	Step in speed	Total length in words	Total length in standard words
50	47.3		150	141.75
60	58.6	11.3	180	175.75
70	69.8	11.2	210	209.50
80	81.1	11.3	320	324.50
90	90.1	9.0	360	360.50
100	99.6	9.5	500	497.75
110	114.8	15.2	550	573.00
120	128.2	13.4	600	641.00
130	135.1	6.9	650	675.25
140	136.7	1.6	700	683.50
150	153.5	16.8	750	767.00
160	162.0	8.5	800	810.00
170	167.1	5.1	850	835.50
180	183.1	16.0	900	915.25
190	204.7	21.6	950	1023.50

One convenience of the standard word idea is, however, that each examining body can fix for itself the sound-length of its own standard word. It could if it wished fix different lengths for different speeds, though to do so would seem an unnecessary complication and would make it a little more difficult to compare different speeds. The only necessary consideration is that the length should be kept constant from year to year. The maximum standardization would of course arise out of the adoption of a uniform measure of, say, four sounds per standard word, by all examining bodies for all purposes.

The effect of such standardization can best be shown by calculating the total length in standard words per minute of some of the passages analysed above. The results for one set of the passages (A) are shown in Table IX. To make the comparison clearer the size of the step from each speed to the next is included. The following outstanding examples of irregularity are revealed: (a) the difference in speed per minute between the '130' and the '140' tests was only 1.6 standard words while that between the '180' and the '190' was 21.6; (b) the '120' test with 128 standard words a minute was only 9 words less than the '140' with 137 standard words; (c) the '160' test had 162 standard words while the '170' test had 167 such words, a difference of only 5 standard words; (d) six of the steps were less than 10 standard words per minute and 8 were more. Not one was exactly ten. No wonder that one sometimes hears an examinee express the opinion that the '90 passage was easier than the 80'. The results for the other bodies are similar, as an examination of Table X will show. As between the different examinations C/120 was slower than A/110 and the last of E/110; A/140 was slower than B/130; and B/150 was faster than A/160 and C/160. In the two slowest and three fastest speeds of the 'B' examinations the standard word rate was higher than the word rate, while in the five central speeds (80 to 120) the reverse was the case. This point is important when it is realized that the central speeds are the most popular. One is forced to the conclusion that, careful as the examining bodies have been, they have not succeeded in standardizing their examinations.

TABLE X

COMPARISON OF EXAMINATIONS IN SPEED IN STANDARD WORDS PER MINUTE

Original speed in words per minute	A	B	C	D	E
50	47	—	—	—	—
60	59	61	—	—	—
70	70	72	—	—	—
80	81	73	80	79 80 77 81	82 78 76 78 81
90	90	86	92	—	—
100	100	94	108	—	—
110	115	108	112	—	113 113 112 111 115
120	128	117	114	—	—
130	135	138	130	—	—
140	137	148	143	—	—
150	154	165	149	—	—
160	162	—	162	—	—
170	167	—	—	—	—
180	183	—	—	—	—
190	205	—	—	—	—

VIII

QUARTER-MINUTE SECTIONS

SHORTHAND DICTATION PASSAGES ARE ALMOST INVARIABLY divided into quarter-minute sections, and the dictator must keep each section within its bounds. Although the intention is thus to regulate the speed more carefully, strangely enough it has the opposite effect. It is possible for one particular quarter-minute section to contain relatively long words and for the next to be comprised of relatively short ones. The result is that the former section is dictated at a relatively fast speaking-rate and the latter at a relatively slow one. If the dictator were permitted to maintain the same speaking-rate throughout each minute much of the irregularity would be reduced. In a short section there is less opportunity for short words to compensate for long, less chance for averages to become constant from passage to passage. This would be seen in its extreme form if in a passage at, say, 60 words a minute, each word were to be allowed exactly one second. We can well imagine the irregularity in a passage like this: The / situation / is / undoubtedly / embarrassing / the / local / bodies /. The sound-lengths may be written thus: 2/9/2/10/9/2/5/5/. If the first and every alternate bar are removed, the section lengths (two seconds each) become much more regular —11/12/11/10/. Even with sections involving thirty or more words, however, a difference still persists, as the following examples, both from the same test, show:

. . . / in transferring their funds, and the disconcerting fluctuations in exchange, in spite of the precautions—sometimes very costly—which they took weighed heavily on their balance sheet; shareholders would therefore appreciate the almost insurmountable difficulties they had encountered./

. . . / carry in its train loading, so to speak, the burdens of the past on those of the present and the future. Can it be that after all man is not sufficiently endowed to achieve what his mind/ . . .

There are 206 sounds in the former and 131 in the latter, that is, the former has 51.5 standard words of four sounds each and the latter 32.75. The whole test averaged 165 standard words a minute (41.25 a quarter-minute), while the word rate was 150 (37-38 a quarter-minute).

As was shown above (p. 38) the normal rate of speech can be measured much more accurately in sounds per minute than in words. In the experiment referred to the two extracts above took 14.7 and 10.3 seconds respectively to read; the time per word was 0.39 and 0.28 seconds respectively. Sound-length and speaking-time are closely related.

Every girl who has practised shorthand speed tests has had the experience of alternating bursts of faster speed with spells of slower. Even a person unfamiliar with shorthand would realize that the outline length of the first passage above was much longer than that of the second. It could not well be otherwise in a phonetic system. The effect is that a girl who can write a steady rate of 80 standard words a minute may fail in an examination because she misses words in one burst at high vocal speed. Further, even a girl who can write a steady 90 standard words a minute may fail in an ordinary 80 words a minute test because of its irregularity. It is exceedingly difficult to obtain a piece

TABLE XI

MEASUREMENTS OF FIFTEEN PAIRS OF QUARTER-MINUTE SECTIONS COMPARED

Section No.	No. of words	No. of syllables	No. of sounds	Speaking time in seconds
1 (a)	20	41	102	7.28
(b)	20	22	65	5.00
2 (a)	20	35	98	7.30
(b)	20	26	70	5.48
3 (a)	28	55	151	10.74
(b)	28	33	87	6.64
4 (a)	28	55	145	10.12
(b)	28	37	94	7.18
5 (a)	20	36	102	7.34
(b)	20	26	65	5.00
6 (a)	20	34	97	6.94
(b)	20	27	63	4.98
7 (a)	17	36	97	6.94
(b)	17	19	54	4.24
8 (a)	23	40	104	7.24
(b)	22	28	68	5.71
9 (a)	27	49	129	8.66
(b)	27	33	83	6.56
10 (a)	35	64	177	12.28
(b)	35	47	126	9.14
11 (a)	38	71	206	14.66
(b)	37	48	131	10.30
12 (a)	20	37	101	7.22
(b)	20	23	61	4.74
13 (a)	23	42	119	8.22
(b)	23	29	73	5.54
14 (a)	33	60	172	11.54
(b)	32	45	111	8.04
15 (a)	35	63	163	11.56
(b)	35	44	118	9.10

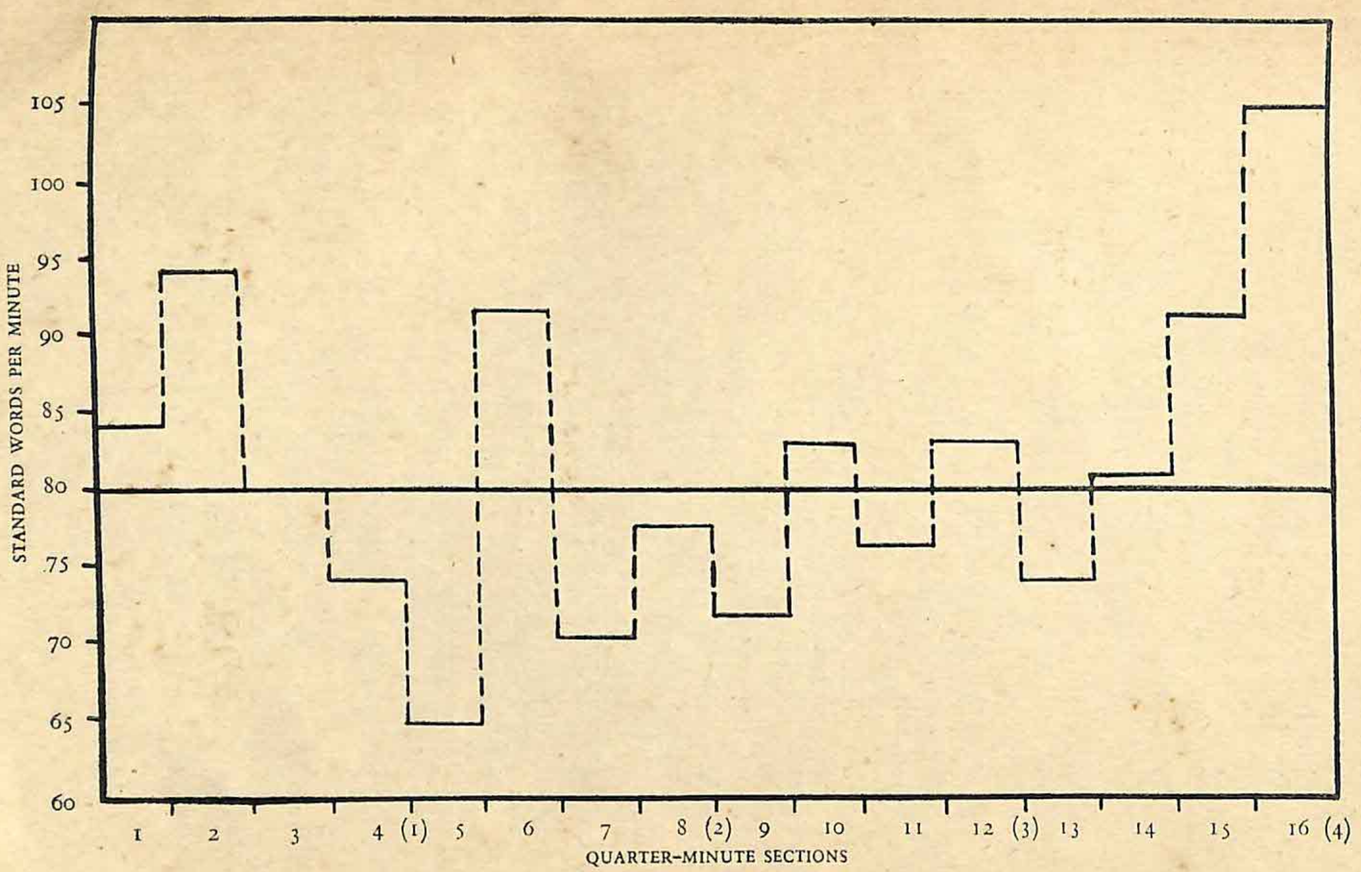

Fig. V. Speed in standard words per minute of quarter-minute sections of a test at 80 words a minute. See also Table XII.

of suitable prose with absolute regularity in quarter-minute sections. It is only by measuring a passage in standard words and dividing the passage into quarter-minute sections on the same basis that irregularity can be overcome.

To illustrate still further the point at issue, to indicate the extent of the variation, and to show that it is no rare occurrence, fifteen pairs of quarter-minute sections, each pair from one test, were chosen from the forty-eight complete examination passages previously discussed. Table XI shows the details.

Table XII shows for four complete passages from the examinations of one authority (A) the 'standard word per minute' speed of the quarter-minute sections. It is easy to see when the examinee will be idling along below her full speed capacity and when she will be making desperate efforts to keep up with the dictator who has outstripped her. For example, the '80' passage drops to only 62 standard words a minute and yet finishes at 104. (Fig. V illustrates the point.) Similar conditions obtain in the other passages; the '130' passage fluctuates between 107 and 163; the '150' passage begins with 170 standard words a minute and then immediately drops to 118, going up a minute later to 184; the '190' passage goes as high as 242 standard words a minute and as low as 178. The ups and downs are quite irregular.

It may be argued that the writer's memory will hold the words as in a reservoir with speech-sounds flowing in at an irregular rate and being drawn out at a regular rate. No doubt all shorthand writers can maintain such a reservoir, the total capacity of which will vary from writer to writer. In examinations counted in words that reservoir has been relied on to a considerable extent, and without it the word method of marking off quarter-minute sections of varying sound-length would have been unworkable. There seems to be no doubt that in some tests ability to keep in the memory

TABLE XII

SPEEDS IN STANDARD WORDS PER MINUTE OF QUARTER-MINUTE SECTIONS OF FOUR EXAMINATIONS

Minute	Section	80 words per minute	130 words per minute	150 words per minute	190 words per minute
	1	84	121	170	210
	2	94	131	118	203
	3	80	134	150	200
1	4	74	140	159	238
	5	62	107	164	242
	6	92	130	184	211
	7	70	115	140	220
2	8	78	115	139	191
	9	72	139	147	182
	10	83	155	166	198
	11	76	140	142	201
3	12	83	129	141	206
	13	74	141	146	196
	14	81	137	172	214
	15	91	156	162	205
4	16	104	129	168	191
	17	—	141	155	214
	18	—	130	141	198
	19	—	148	146	196
5	20	—	163	160	178
Average in standard words per minute		81	135	154	205

words uttered by the dictator some seconds earlier may be the deciding factor between pass and fail. Furthermore, this capacity makes up for a slower shorthand speed. A good writer with it well developed may rely on it and pass without having the power to write temporarily at a faster rate. One with a poor verbal reservoir must have a reserve of speed to keep up with the dictator the whole time.

Table XII also shows the varying extent of the call upon the verbal memory capacity. In the test at 190 words a minute the fourth, fifth, sixth, and seventh sections were all above the average standard word rate of 205. With no increase in writing speed above this average, there would be a 'carry forward' from the fourth to the fifth section of 8.25 standard words, from the fifth to the sixth of 17.5, from the sixth to the seventh of 19, and from the seventh to the eighth of 22.75. To do so is by no means an easy task, and it is not standardized. Further, when the last quarter-minute section is at a high standard word speed, there is no opportunity for a writer to catch up during a later slower section. There is, however, no uniformity in the speed of the last sections, as may be seen from Table XII. The concluding section of the '80' passage has a standard word speed of 104; that of the 130 word passage one of 163; that of the '150', one of 160; and that of the 190 word passage has a final section at only 178 standard words a minute.

Strangely enough, at very high speeds irregularity tends to correct itself, for the dictator cannot keep exactly to the quarter-minute sections. He speaks in sounds, and when he cannot get all the words of a long-word section into the fifteen seconds the excess is carried over into the next quarter-minute. Here again standardization can be achieved by measuring in standard words. So doing would regulate the inflow into the verbal reservoir, and as the outflow in symbols closely correlates with this inflow, the content of the reservoir would thereby be regulated. The variations in speed would also be removed, as all shorthand writers under the standard word method invariably testify.

IX

COUNTING SOUNDS

IF THE PROPOSALS MADE IN THIS STUDY TO USE SOUNDS AS the unit of measurement in shorthand passages are to be put into practice, some uniform system of counting sounds is needed. In the analysis of the forty-eight dictation tests given earlier, I used *An English Pronouncing Dictionary* by Daniel Jones. It is by far the most easily used dictionary for the purpose, but each examining authority could specify what dictionary would be its guide. It is true that each system of shorthand has its own variety of phonetics; but in a public examination open to writers of all systems these variations would be ignored in favour of an independent system, say, that of Jones. Where the examination is in one specific system of shorthand, or where, though it is theoretically open to any system, in practice only one is used, it would be possible to take the phonetics of that system into account, but this would seem to be undesirable, as examinations at corresponding speeds under different systems would not be comparable. I look forward to the time when the proprietors of shorthand systems will in their shorthand dictionaries print a number beside each word to indicate the number of sounds in it, determined by a strictly phonetic method. To do so would facilitate the standardization of their own examinations and of public examinations in their systems, and assist teachers in the preparation of their practice pieces and schools in their internal examinations.

Of course, the inventor of any shorthand system will adopt all the time-saving devices possible, such as, for example, the provision of one symbol for two sounds that occur in combination frequently. To show the extent of the variation that such differences might make, a comparison was made between the 'Jones' sound-length and the 'Pitman' sound-length of the fifteen pairs of quarter-minute sections given previously, with the result shown below:

	Jones	*Pitman*	*Difference*
Average no. of sounds per word..........	4.48	4.42	0.06
Average no. of sounds per section.........	107.70	106.20	1.50

Four extracts were the same under both systems, nine were longer under Pitman's, and seventeen shorter. The greatest difference was 11 (Jones 172 sounds, Pitman 161).

In the pursuit of the ideal method of measurement one might well be led to consider the length of sounds themselves. For example, 'noon' is a longer word than 'cat' though each has three sounds, and a passage of, say, 1000 speech-sounds the majority of which are long constitutes a longer current of speech than a similar one consisting largely of short sounds. If both are spoken in the same time, the former will be faster relatively to the normal rate of utterance in ordinary speech. In shorthand systems this length of sounds is to some extent taken into account, but much more important are the frequency of occurrence of sounds and the combinations in which they occur. The shorthand inventor consequently allocates the quickly written symbols to the frequently occurring sounds. Other things being equal he would naturally try to pair a short sound with a short symbol, but other things are seldom equal. Consequently to take the length of sounds into account in determining the sound-length of a passage would tend to reduce closeness of relationship between the sound-length and the shorthand symbol-length.

Pauses cannot be disregarded by a speaker. They are vital in language, and without them its function would be much less perfectly performed. Moreover, shorthand provides for the use of punctuation marks; yet there is no time allowance for them in shorthand tests. Many shorthand writers leave most of the punctuation till they are preparing the transcript. Theoretically, if the shorthand outlines are taken into account in the award of a pass, and if shorthand punctuation symbols are regarded as outlines, there is no justification for the omission of them in assessing the length and consequently the speed of the passage.

The difficulty of punctuation in the transcript is not standardized at all, but in almost all tests it is very simple. Many tests do not require more than the full stop and the comma. Occasionally a dash or a question mark crops up, and only very rarely are inverted commas required. Provided the punctuation is kept simple its regulation from year to year is a simple matter.

X

SUMMARY

THE PRINCIPAL PURPOSE OF THIS INVESTIGATION WAS TO FIND a measuring-rod, or scale of difficulty, with which to assess in advance the difficulty of shorthand examinations. Examination procedures were discussed and the need for standardizing both the environmental conditions and those activities which constitute a part of the examination, e.g. dictating, was dealt with. The extent of vocabulary, and the familiarity and frequency of words, should also be regulated as much as possible.

A discussion of possible units of measurement of length brought out the following points:

The sound: (a) it is the logical unit to use to measure a phonetic system of symbol writing; (b) it is the best indirect measure of the Pitman symbol-length; (c) measurement in sounds correlates extremely closely with speaking-time-length; (d) sound-length would not be adequately measured by letters or syllables; (e) sound-length correlates to a significant extent with shorthand time-length.

The letter: (a) in a language such as English it is illogical to measure a phonetic system in letters; (b) the letter-length would tend to measure long words short and short words long; (c) the letter-length of the word correlates to a significant extent with shorthand time-length, but it does not correlate as highly as the sound-length with symbol-length of the passages; (d) letters are more definite than sounds and can be more easily counted.

The syllable: (a) it is insufficiently stable in both sound- and letter-length; (b) it tends to shorten in letter-length as the syllable-length of the word increases; (c) syllable-length correlates with shorthand time-length to a smaller degree than the letter-length or the sound-length; (d) it is not nearly as efficient in measuring Pitman symbol-length as the sound or the letter.

The word: in every respect except simplicity in counting it is found to be the least satisfactory.

The sound was regarded as the best unit of measurement, being followed closely by the letter; the syllable came next, and the word last.

The average word in examination passages has a length of approximately four speech-sounds. Four speech-sounds may then constitute the standard word. Examinations, measured in standard words, have varied greatly in length, not only from one examining authority to another, but also from year to year and from speed to speed, and in a quite irregular fashion. Very great irregularity in the lengths of quarter-minute sections also exists.

The main recommendations of this study are:

(1) A complete code of standard examination procedure should be developed by examining authorities.

(2) The extent of the vocabulary to be used in test passages should be fixed.

(3) In tests, word familiarity should be regulated on the basis of the frequency with which words occur in the language.

(4) Word and outline frequency in the test passages should be standardized as much as possible.

(5) Passages should be measured in sounds, preferably at the rate of four speech-sounds to the standard word.

(6) Quarter-minute sections should also be marked off in standard words.

TABLES

TABLE A

SYMBOL, SYLLABLE, SOUND, AND LETTER LENGTH OF THIRTY PASSAGES OF 100 WORDS EACH

Passage number	Symbol length	Syllabic length	Sound length	Letter length
1	203	165	445	483
2	200	171	450	492
3	197	149	438	466
4	250	193	531	569
5	242	192	523	560
6	275	206	596	625
7	197	164	429	479
8	199	158	418	470
9	186	145	410	450
10	205	163	429	475
11	197	157	422	461
12	227	172	483	516
13	198	157	428	467
14	191	153	406	446
15	178	142	393	436
16	165	131	351	404
17	188	133	372	421
18	182	137	370	409
19	188	144	388	436
20	180	155	409	463
21	203	164	432	483
22	183	137	380	432
23	193	146	395	438
24	195	157	422	470
25	171	140	369	427
26	192	151	421	466
27	178	138	377	425
28	232	189	481	549
29	217	164	448	498
30	175	118	341	390

TABLE B

INDEX NUMBERS FOR SYMBOL, SYLLABLE, SOUND, AND LETTER LENGTH OF AVERAGE WORD IN EACH OF THIRTY SELECTED PASSAGES

(Average of all passages is base)

Passage number	Symbol length base 2 = 100	Syllable length base 1.56 = 100	Sound length base 4.25 = 100	Letter length base 4.70 = 100
1	101.5	105.5	104.6	102.8
2	100.0	109.3	105.9	104.7
3	98.5	95.3	102.9	99.2
4	125.0	123.4	125.0	121.1
5	121.0	122.8	123.1	119.2
6	137.5	131.7	140.3	133.0
7	98.5	104.9	101.0	101.9
8	99.5	101.0	98.3	100.0
9	93.0	92.7	96.5	95.7
10	102.5	104.2	100.9	101.1
11	98.5	100.4	99.3	98.1
12	113.5	110.0	113.5	109.8
13	99.0	100.4	100.6	99.4
14	95.5	97.7	95.5	94.9
15	89.0	90.8	92.4	92.8
16	82.5	83.8	82.6	86.0
17	94.0	85.0	87.6	89.6
18	91.0	87.6	87.1	87.0
19	94.0	92.1	91.2	92.8
20	90.0	99.1	96.1	98.5
21	101.5	104.9	101.7	102.8
22	91.5	87.6	89.3	91.9
23	96.5	93.4	93.0	93.2
24	97.5	100.4	99.3	100.0
25	85.5	89.5	86.9	90.9
26	96.0	96.6	98.8	99.2
27	89.0	88.5	88.8	90.4
28	116.0	120.8	113.1	116.8
29	108.5	104.9	105.4	105.9
30	87.5	75.5	80.3	83.0

TABLE C

INDEX NUMBERS FOR SOUND AND LETTER INTENSITY OF THE SYLLABLE IN THIRTY PASSAGES

(Average of all passages is base)

Passage number	Sounds base: 2.72 = 100	Letters base: 3.02 = 100
1	99.3	97.4
2	97.1	95.4
3	107.7	103.7
4	101.1	97.6
5	100.4	96.9
6	106.6	100.8
7	96.3	96.9
8	97.1	98.4
9	103.7	102.6
10	96.3	96.4
11	98.9	97.6
12	103.3	99.5
13	100.0	98.7
14	97.4	96.9
15	101.1	101.4
16	98.2	102.1
17	103.3	105.5
18	99.3	99.1
19	98.9	100.3
20	96.7	98.7
21	97.1	97.8
22	101.8	104.4
23	99.6	99.5
24	98.9	99.4
25	97.4	101.5
26	102.3	102.3
27	100.4	101.4
28	93.8	96.5
29	100.4	100.8
30	106.3	109.8

TABLE D

SYMBOL-LENGTH OF THE SYLLABLE, THE SOUND, THE LETTER, AND THE WORD EXPRESSED AS PERCENTAGE OF AVERAGES

	SYMBOLS			
Passage no.	per syllable	per sound	per letter	per word
1	96.5	97.0	98.8	101.5
2	91.8	94.5	95.8	100.0
3	103.5	96.0	99.8	98.5
4	101.2	100.2	103.5	125.0
5	98.8	98.5	101.7	121.0
6	105.1	98.9	100.9	137.5
7	94.1	97.7	96.9	98.5
8	98.8	101.5	99.8	99.5
9	100.4	96.4	97.4	93.0
10	98.8	101.9	101.9	102.5
11	98.0	99.2	100.5	98.5
12	103.5	100.2	105.2	113.5
13	98.8	98.5	100.0	99.0
14	94.9	100.4	101.2	95.5
15	97.3	96.2	96.0	89.0
16	98.8	100.0	96.2	82.5
17	111.4	107.5	105.2	94.0
18	104.3	104.5	104.7	91.0
19	102.0	103.0	101.4	94.0
20	97.1	94.0	92.0	90.0
21	97.3	99.6	98.0	101.5
22	104.3	102.6	100.0	91.5
23	103.5	104.3	104.0	96.5
24	97.3	98.1	97.6	97.5
25	96.5	98.5	94.6	85.5
26	99.6	97.0	97.2	96.0
27	101.2	100.4	98.8	89.0
28	96.5	102.8	99.8	116.0
29	103.5	102.8	102.6	108.5
30	116.1	109.2	105.7	87.5

TABEL E

SYLLABLES, SOUNDS, AND SPEAKING-TIME PER WORD OF THIRTY EXTRACTS FROM DICTATION TESTS

Extract number	Syllables per word	Sounds per word	Average speaking-time per word in seconds
1 (a)	2.10	5.05	.36
(b)	1.10	3.25	.25
2 (a)	1.75	4.90	.37
(b)	1.30	3.50	.27
3 (a)	1.96	5.39	.38
(b)	1.18	3.11	.24
4 (a)	1.96	5.18	.36
(b)	1.32	3.36	.26
5 (a)	1.80	5.10	.37
(b)	1.30	3.25	.25
6 (a)	1.70	4.85	.35
(b)	1.35	3.15	.25
7 (a)	2.12	5.71	.41
(b)	1.12	3.18	.25
8 (a)	1.74	4.52	.32
(b)	1.27	3.08	.26
9 (a)	1.82	4.78	.32
(b)	1.22	3.07	.24
10 (a)	1.83	5.06	.35
(b)	1.34	3.60	.26
11 (a)	1.87	5.42	.39
(b)	1.30	3.54	.28
12 (a)	1.85	5.05	.36
(b)	1.15	3.05	.24
13 (a)	1.83	5.17	.36
(b)	1.26	3.17	.24
14 (a)	1.82	5.21	.35
(b)	1.41	3.47	.25
15 (a)	1.80	4.66	.33
(b)	1.26	3.37	.26

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